

Claims

- [c1] 1. An electronic module assembly with reduced EMI noise emission from an electronic module component that emits EMI noise, the assembly comprising:
- a first electric reference region in communication with the electronic component, the first electric reference region being characterized by a first electromagnetic noise signal;
 - a second electric reference region characterized by a second electromagnetic noise signal;
 - an impedance component in series with the first reference region and the second reference region such that the impedance component attenuates the first electromagnetic noise signal such that the magnitude of the second electromagnetic noise signal is less than the magnitude of the first electromagnetic noise signal; and
 - a low pass filter component in communication with the electronic module and referenced to the second electric reference region, the low pass filter component attenuating electromagnetic noise on one or both of input signals to the electronic module component or output signals from the electronic module component.

- [c2] 2. The electronic module assembly of claim 1 wherein the low pass filter component is an active or passive low pass filter.
- [c3] 3. The electronic module assembly of claim 1 wherein the low pass filter component is a shunt capacitor with a first terminal in electrical contact with the second reference region and a second terminal in electrical communication with the input or output signals of the electronic component.
- [c4] 4. The electronic module assembly of claim 1 wherein the low pass filter component comprises common mode inductors with a shunt capacitor between each input to the common mode inductors.
- [c5] 5. The electronic module assembly of claim 2 wherein the low pass filter component has a time response from about 0.01 milliseconds to about 10 milliseconds when the first electromagnetic noise signal has a frequency from about 0.1 to about 100KHz.
- [c6] 6. The electronic module assembly of claim 5 wherein the low pass filter component has a time response from about 0.01 microseconds to about 10 microseconds when the first electromagnetic noise signal has a frequency from about 0.1MHz to about 100MHz.

[c7] 7. The electronic module assembly of claim 1 wherein the low pass filter component and the electronic module component reside on the same circuit board.

[c8] 8. The electronic module assembly of claim 1 wherein the low pass filter component and the electronic module component reside on separate circuit boards.

[c9] 9. The electronic module assembly of claim 1 wherein the magnitude of the impedance of the impedance component is from about 1 ohm to about 500 ohms.

[c10] 10. The electronic module assembly of claim 9 wherein the magnitude of the impedance of the impedance component is from about 2 ohms to about 200 ohms.

[c11] 11. The electronic module assembly of claim 10 wherein the magnitude of the impedance of the impedance component is from about 5 ohms to about 50 ohms.

[c12] 12. An electronic module assembly with reduced EMI noise emission, the assembly comprising:
a first circuit board;
an electronic module component that emits EMI noise;
a first electric reference region in communication with the electronic component, the first electric reference region being characterized by a first electromagnetic noise

signal;
a second electric reference region characterized by a second electromagnetic noise signal;
an impedance component in series with the first reference region and the second reference region such that the impedance component attenuates the first electromagnetic noise signal so that the second electric reference region is characterized by a second electromagnetic noise signal wherein the magnitude of the second electromagnetic noise signal is less than the magnitude of the first electromagnetic noise signal;
a second circuit board; and
a low pass filter component residing on the second circuit board in communication with the electronic module and referenced to the second electric reference region, the low pass filter component attenuates electromagnetic noise on one or both of input signals to the electronic component or output signals from the electronic module.

[c13] 13. The electronic module assembly of claim 12 wherein the low pass filter component is an active or passive low pass filter.

[c14] 14. The electronic module assembly of claim 12 wherein the low pass filter component is a shunt capacitor with a first terminal in electrical contact with the second refer-

ence region and a second terminal in electrical communication with the input or output signals of the electronic component.

- [c15] 15. The electronic module assembly of claim 12 wherein the low pass filter component has a time response from about 0.01 milliseconds to about 10 milliseconds when the first electromagnetic noise signal has a frequency from about 0.1 to about 100KHz.
- [c16] 16. The electronic module assembly of claim 12 wherein the low pass filter component has a time response from about 0.01 microseconds to about 10 microseconds when the first electromagnetic noise signal has a frequency from about 0.1MHz to about 100MHz.
- [c17] 17. The electronic module assembly of claim 12 wherein the magnitude of the impedance of the impedance component is from about 5 ohms to about 50 ohms.
- [c18] 18. A method of reducing noise on input and output signals to an electronic module which resides on a first electric reference region characterized with a first electromagnetic noise signal, the method comprising:
reducing the electromagnetic noise by positioning an impedance component in series with the first electric reference region and a second electric reference region,

the second electric reference region being characterized by a second electromagnetic noise signal that is less than the first electromagnetic noise signal because of attenuation of the first electromagnetic noise signal by the impedance component; and
filtered one or both of an output signal and an input signal to the electronic module with a low pass filter component referenced to the second electric reference region.

[c19] 19. The method of claim 18 wherein the low pass filter component is an active or passive low pass filter.

[c20] 20. The method of claim 18 wherein the low pass filter component is a shunt capacitor with a first terminal in electrical contact with the second reference region and a second terminal in electrical communication with the input or output signals of the electronic component.

[c21] 21. The method of claim 18 wherein the low pass filter component has a time response from about 0.01 milliseconds to about 10 milliseconds when the first electromagnetic noise signal has a frequency from about 0.1 to about 100KHz.

[c22] 22. The method of claim 18 wherein the low pass filter component has a time response from about 0.01 mi-

croseconds to about 10 microseconds when the first electromagnetic noise signal has a frequency from about 0.1MHz to about 100MHz.

[c23] 23. The method of claim 18 wherein the magnitude of the impedance of the impedance component is from about 5 ohms to about 50 ohms.